

USE OF VIBRATION ENERGY FOR CHARGING ELECTRIC CAR

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ABSTRACT

In today's world, Electric cars are gaining a great demand with increasingly new features established in them and rising demand of eco friendly status for each one of us. Electric cars which uses electricity to charge up their batteries; have replaced gasoline and diesel cars with features like high speed, less carbon emission, less maintenance, upto certain level with better mileage etc but brought a great disadvantage of a big threat to non-renewable electrical energy. So, in this paper, our focus is on charging electric cars via some source which exist in long and does not become costly i.e. vibrating energy which totally replaces electricity and uses vibrations present around us which are harvested economically. According to World Bank Report 4,50,000 vehicle passes from the busiest highways which produces plenty of vibrations. Thus here we are trying to use this vibration energy with piezoelectric transducers (which converts mechanical energy to electrical energy) with springs which finally results in electrical energy.

Key words: Fossil fuel, Electric car, Vibrating energy, Piezoelectric devices, transducers, springs, Electric Energy,

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1. INTRODUCTION

Car, Today has become a necessary part for today's world. Automobile has provided us with so many advancements and freedom as far as mobility and transportation is concerned. It makes the life of people all together very easy dynamic and energy dependent Thus automobile has become an important part in today's competition and business world & also shows one's social and economic status in the market, But at

the same time when it shows so much of positivity it shows few disfavours also. Firstly, cars operate using fossil fuel i.e. cars run on fuel obtained from fossil in which huge amount of carbon and green house complex are present. According to the report of International Transport Organization approximately there are 210 million vehicles on Roads of India till 2011 which according to another survey was around 155 million in 2009.

For such a large number of motor vehicles lot of petrol/diesel is used which is very limited, non-renewable resource and adds massively to green house effects and Impact on Climate in long run. With change in time, came a new trend of electric cars which uses electricity as its fuel, and this consumption in early days was in a very mere scale but as the trend moved towards electric cars gradually, the use of electricity as fuel for it increased. Thus in this paper we have introduced a new concept of charging electric cars using some alternative source of energy, vibrating energy.

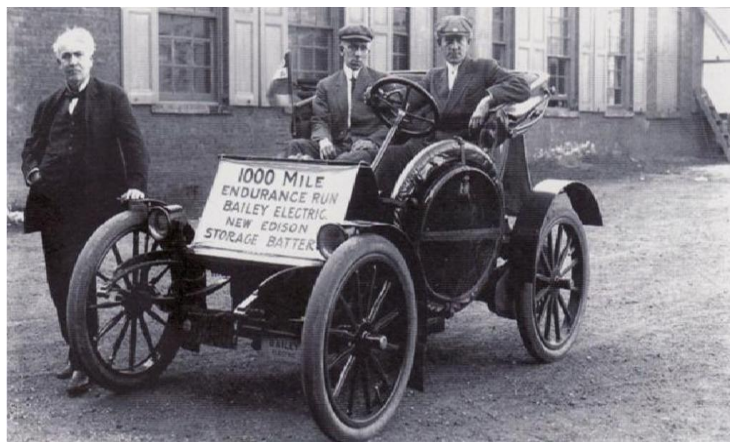


Figure First practical electric car By Thomas Parker

With the invention of new technologies in 1900 for electric car 40% of American automobiles were powered by steam, 38% by electricity and 22% by gasoline, and now electric vehicle scale rose up to an approximation of 30,000 in 20th century.

2. BRIEF DISCRPTION

A huge number of vehicles pass from highway which produces vibrations which are further used to generate electrical energy. And this redeem our electricity to a great extend. piezoelectric devices, which converts mechanical energy into electrical energy with piezoelectric materials through piezoelectric effect. Piezoelectric devices are used in many applications such as power harvesting shoes, Piezoelectric fans etc.

In electric cars vibration energy produced while their running can also be converted into electricity by piezoelectric devices (harvesters). This electricity can be stored in batteries. In this paper, we discuss about electric car then how the electric car can be charged through vibrations using piezoelectric devices.

2.1 Converting Vibrational Energy to Electric Energy

Unlike other electric cars that rely on special charging stations or an extension cord plugged into an outlet at home, the electric car charged by the vibration energy relies on piezoelectric devices to charge the car's battery as it moves.

The vehicles on road waste a major fraction of energy that can be harvested for good use. For every second a vehicle whether electric semi auto or manual moves or passes by the road, it's bounces & vibrations are the movements that could be

harnessed by piezoelectric devices to generate electricity that could recharge the battery. With piezoelectric devices located on both sides of each passenger seat, this concept car could keep it running efficiently with no additional expense for electricity or gasoline as it can be reverted from Vibration energy a form of waste energy as It goes in vane and further only damages the road by continuous impact on it. The electric car would obviously need another source of energy as a back-up but the load can be decreased upto 30-35% of present need by eventually using up all the capable vibration energies.

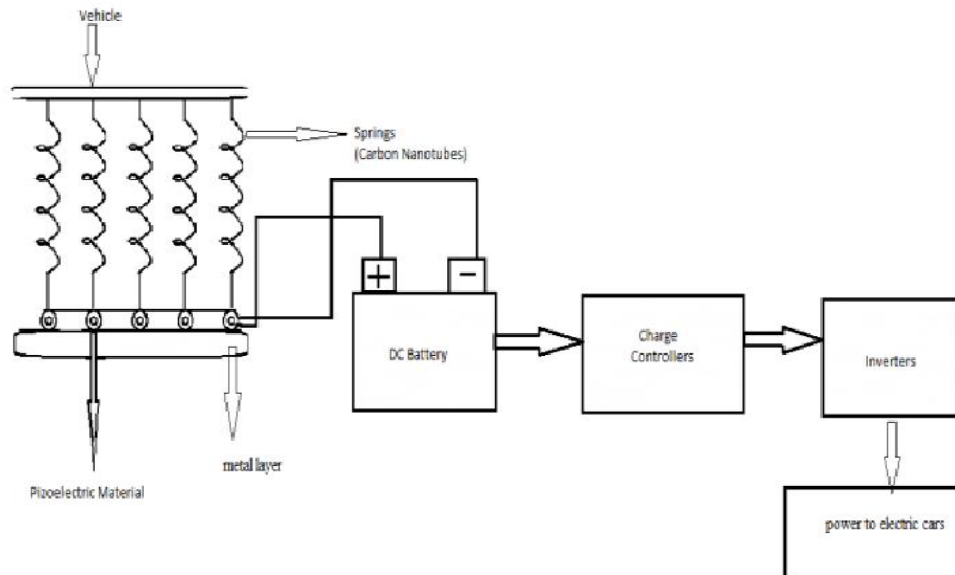


Figure Electric cars charged via vibrating energy

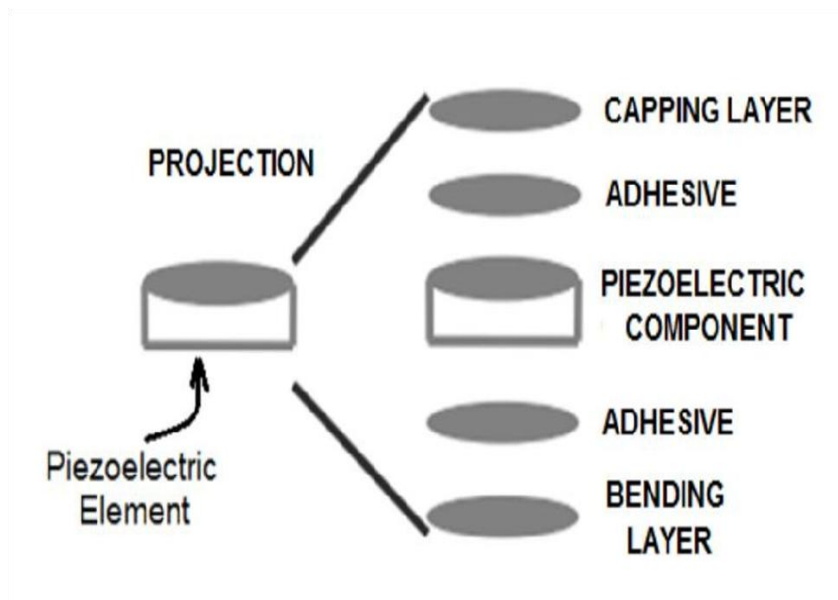


Figure Structure of piezoelectric element

2.1.1 Piezoelectric Materials

The word piezoelectricity defines “electricity produced due to pressure”. Piezoelectric effect is the generation of electrical charge resulting from mechanical strain (force), and the materials which are used to show this type of property are termed as piezoelectric material\crystals. Piezoelectric materials have a crystalline structure with the help of which we can produce electrical energy from mechanical vibrations. The materials showing this property as inherent property are crystals of tourmaline, quartz, topaz, and Rochelle salt. Since piezoelectric materials directly convert mechanical strain to electrical energy, they have now become most attractive functional materials for sensors and actuators.

When vibrations through spring is produced on the piezoelectric material through mechanical stress like through load from vehicles, humans foot, railway tracks, dance floors, etc. then positive and negative charge centre's shift which results in an external electrical field. For such conversion firstly, mechanical strain causes generation of mechanical energy which is then converted into a.c voltage and then again converted to d.c voltage. Thus electronic charge gets accumulated in response to mechanical strain applied. When certain crystals are strained, polarization takes place and the amount of polarization is directly proportional to the stress applied. And thus piezoelectric crystals are used to harvest the energy produced by the vibrations from traffic on the road or moving vehicles on highways expressways.

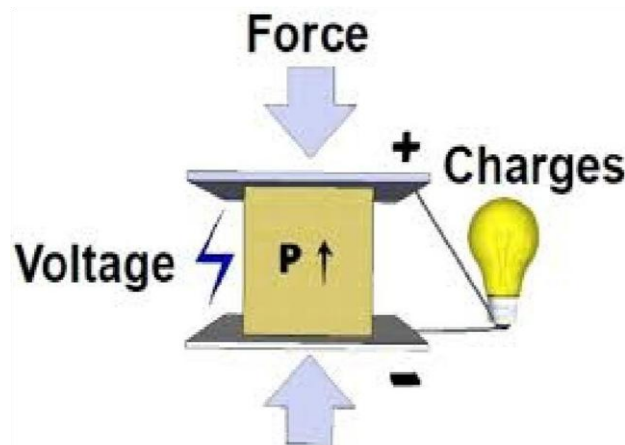


Figure Showing energy generation through vibration

2.1.2 Springs

Spring plays very crucial role as far as this methodology is concerned. Here, in this method the spring contracts and expands which results in production of electric flux. Also, when spring contracts and expands continuously several number of times, it taps and gives mechanical strain, which creates a mechanical stress on the piezo- electric crystal placed just below the springs. This leads to electromagnetic induction finally resulting into electric voltage. Contrary, we use carbon nano tubes-tube shaped molecules of pure carbon which can be formed into tiny springs. The main reason behind using carbon-nano tubes is that they are capable of storing a large amount of energy (in several pounds) and are more durable and reliable. In an comparison, for the same weight nano-tubes can produce and store in them more than 1000 times as compared to steel springs. These springs are temperature resistant that is they are not affected by temperature changes.

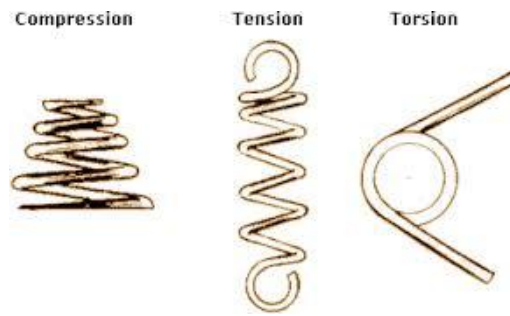


Fig:-Spring Actions

2.1.3 Vibration Energy to Electric Energy

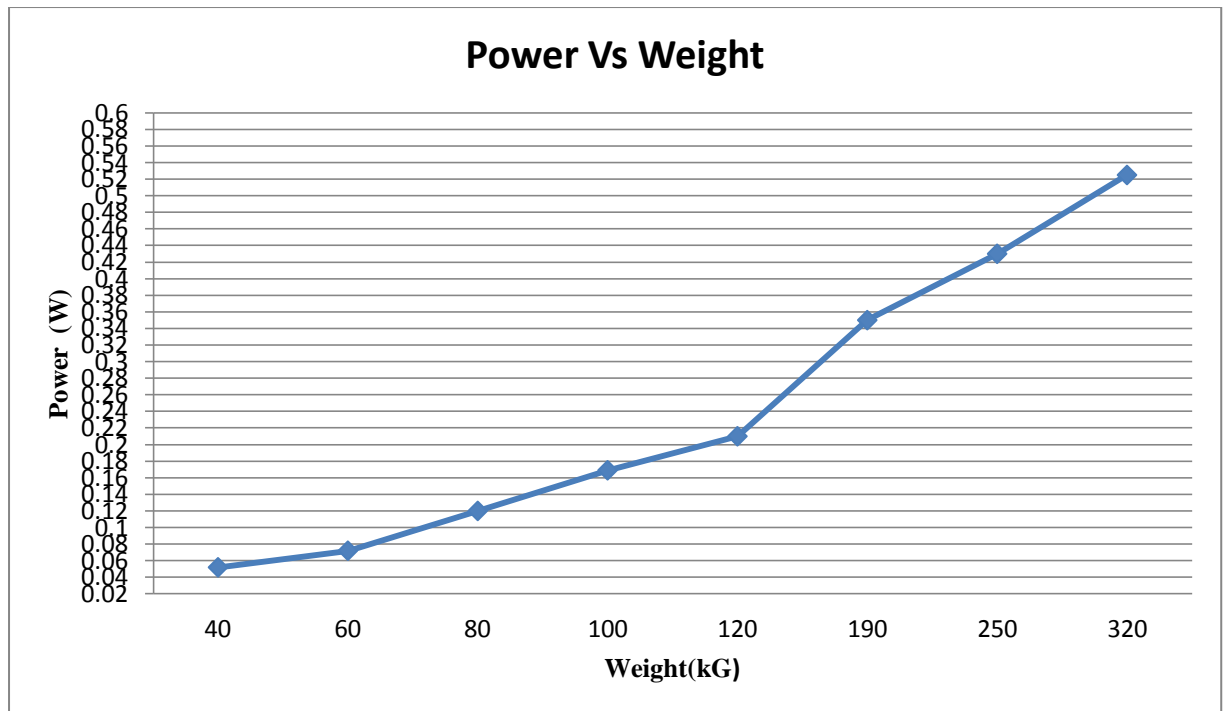
We are harvesting this vibration energy using piezoelectric crystals, working on piezoelectric effect. That is, when no pressure is applied on the crystals of piezoelectric material, the centre's of the negative and positive charges concurs on each other. The overall effect is cancelled and thus that material is neutral.

After when pressure is exerted on the piezoelectric crystals, they force to change the internal structure and now positive and negative charges do not coincide as earlier, which results in generation of dipoles which further results in a polarized molecule. This polarized molecules in the material itself when come in majority that is most of the molecules are polarized, it generates an electric field whose intensity or electric line of forces depends on degree of polarization which further depends on the quantity of vibrations or displacement occurred. This electric field generated transforms mechanical energy directly into electrical energy. The a.c voltage generated over here is then converted into d.c voltage using rectifiers.

3. METHODOLOGY

Conversion of vibration energy caused by vehicles into electrical energy occurs in the given manner. When vehicles/traffic passes on through the chosen particular area, it tends to contract the springs placed at the level of the road sometimes just below the road (one with increased sensitivity and long lasting life can be buried (05-1.5 m). Now when vehicle passes, spring continuously expands and contracts, which continuously comes in contact with piezoelectric crystals which creates a pressure on the crystals. When pressure is exerted, it results in deformation and movement of positive and negative charges which induces electric field and finally electrical energy. This output is further fed to rectifier which converts a.c into d.c. either of the half wave or full wave rectifier can be used in for this purpose. Further microcontroller displays the live status of battery that is, what percentage of battery gets charged whenever vehicle passes on from the layer of piezoelectric transducers. After this output is fed to inverters; an electrical device that converts d.c to a.c. and finally electrical energy gets saved in inverters only and can be used further when needed. The output obtained from a single piezoelectric crystal is in mili volts range. So, we arrange many piezoelectric crystals in series so as to obtain higher voltage. And the received energy is stored in lithium batteries.

A general experiment was conducted in for Piezoelectric material used under different loads and a graph between Piezoelectric voltage and Load was plotted which is shown in Graph no.-1. This experiment gave a clear picture as what level of voltage can be gained out from the piezoelectric material under the roads having load of thousands of tonnes per day sometimes per hour.



4. ENERGY STORAGE

The harvested energy can be stored in rechargeable batteries or super capacitors, or both. The range of products available is vast, ranging from systems that can start a truck with a flat battery from cold, to subminiature devices operating at the μV level. If an application requires high level of power, then a fast charge/discharge super capacitor may be the best solution. If low levels of power are required to be released slowly over a long period of time, then rechargeable batteries are a better best solution.

5. APPLICATIONS

1. Piezoelectric road harvests traffic energy to generate electricity. Israeli engineers are about to begin testing a 100 meter stretch of roadway embedded with a network of Piezo Electric Generators
2. Practical application of Piezo smart roads :-The piezoelectric energy-generating roads have been proposed in the car capitol of the world –California. This design is based on the concept of piezoelectricity that is produced in response to the mechanical stress applied on some solid materials like crystals and some ceramics. The design proposes the placement of piezoelectric sensors beneath the road surface which would produce electricity from the vibrations caused by the movement of vehicles on the road. When applied on roads, the piezoelectric technology could produce up to 44 megawatts of electricity per year from one kilometer stretch of the road and meet the energy demand of about 30,800 households.
3. To light up street lights in this we used this energy to charge electric cars, at that place we can use this energy to light up street lights.
4. Power generating sidewalk the piezoelectric crystal arrays are laid underneath pavements where a huge crowd passes creating vibrations.
5. In Railway tracks A moving train produces an ample amount of vibrations. Thus piezoelectric crystals are mounted nearby to use those vibrations.

6. CONCLUSION

From this paper we tried to give an attention towards the new way in which a new technology which is present in front of us for generating electrical energy. This technology is based on a form of energy which is yet treated as a error or waste in terms of science and has got a social status of un-useful. Since electrical energy is non- renewable hence there is a great need to save electrical energy efficiently and effectively. Thus, by collaborating this vibration energy with electric cars can save a huge amount of electricity which might have been used in recharging the cars and that saved electricity can be used to light up many lives hopes as still nearly 2 out of 17 people in India are in uncovered shed of light (Non electrified zone) against the world average of around 42%. In this concept the Piezoelectric materials plays a very crucial and important role. The Piezoelectric materials have the ability to sense the mechanical strain and transform it into mechanical energy and further converted to electrical energy. The amount of energy generated depends on the number of passing vehicles and the number of piezoelectric elements on and around the road. Then this received energy is stored in batteries. This idea can be used anywhere to generate electricity and is also very cost effective.

7. FUTURE SCOPE

This idea plays a vital role in saving electricity for future generations. This stored electrical energy can be used to power other devices also or can be stored for further use. Also there are many other ways present for us besides electricity to charge up electric cars. These ways can also act as a better substitute to electricity and can be used when electrical energy is not present or in areas where the electricity has not yet reached. We can charge our electric cars by mounting solar panels and charging via solar energy. Also, we can use a turbine mounted at the top of the car so whenever car runs, turbine rotates due to wind energy present which is converted into electrical energy by transducers.

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